We claim:

1. A system for rehabilitation of a hearing disorder, comprising:

at least one acoustic sensor for picking up an acoustic signal and converting it into an electrical audio signal,

an electronic signal processing unit for audio signal processing and amplification,

an electrical power supply unit which supplies individual components of the system with current, and

an actuator arrangement which is provided with at least one output actuator selected from the group consisting electroacoustic, electromechanical, and purely electrical actuators, and any combination thereof, for stimulation of damaged hearing,

wherein the signal processing unit has a speech analysis and recognition module and a speech synthesis module.

2. The system as claimed in claim 1, wherein the signal processing unit has a digital signal processor which contains software modules for speech analysis and synthesis.

3. The system as claimed in claim 2, wherein the speech analysis and speech recognition module and the speech synthesis module are adaptive.

4. The system as claimed in claim 2, wherein the speech analysis and speech recognition module and the speech synthesis module are re-programmable.

5. The system as claimed in claim 1, wherein the speech analysis and speech recognition module and the speech synthesis module include a digitally implemented neural network.

6. The system as claimed in claim 1, wherein the speech analysis and speech recognition module and the speech synthesis module are adapted to transmit phonetic categories between them.

7. The system as claimed in claim 1, wherein the speech analysis and speech recognition module and the speech synthesis module are adapted to transmit lexical categories between them.

8. The system as claimed in claim 1, wherein the speech analysis and recognition module has an arrangement for detecting and extracting additional prosody of the speech information, and wherein the speech synthesis module is provided with an arrangement for taking into account the prosody of speech information in speech synthesis.

9. The system as claimed in claim 8, wherein the arrangement for detecting and extracting prosody of speech information is adapted for extraction of level and characteristic of fundamental speech frequency for voiced sounds, and wherein the arrangement for taking into account prosody of speech information in speech synthesis is adapted to effect the corresponding modulation of the output signal.

10. The system as claimed in claim 1, wherein the speech analysis and recognition module and the speech synthesis module are adapted to be turned off to enable processing of audio signals without speech analysis and synthesis.

11. The system as claimed in claim 10, further comprising means for automatically turning off the speech analysis and recognition module and the speech synthesis module at a low level of interfering sound.

12. The system as claimed in claim 10, further comprising means for turning off the speech analysis and recognition module and the speech synthesis module by remote control.

13. The system as claimed in claim 1, wherein the signal processing unit contains software modules adapted to enable masking of tinnitus parallel to operation of the hearing aid.

14. The system as claimed in claim 1, wherein the signal processing unit has a preprocessing arrangement for at least one of pre-amplification and filtering, and has an A/D converter for analog-digital (A/D) conversion of the acoustic signals.

15. The system as claimed in claim 14, wherein the preprocessing arrangement

comprises an anti-aliasing filter.

16. The system as claimed in claim 1, wherein a plurality acoustic sensors are provided, each of the acoustic sensors being upstream of an analog-digital converter.

17. System as claimed in claim 1, wherein at least one digital-analog converter is connected upstream of the actuator arrangement.

18. The system as claimed in claim 1, wherein the actuator arrangement comprises a plurality of actuators, and wherein a respective digital-analog converter is connected upstream of each actuator.

19. The system as claimed in claim 17, wherein the signal processing unit has a digital signal processor for processing A/D-converted acoustic sensor signals which have been preprocessed by means of the preprocessing arrangement and for generation of digital signals for tinnitus masking.

20. The system as claimed in claim 14, wherein the signal processing unit has a digital signal processor for processing A/D-converted acoustic sensor signals which have been preprocessed by means of the preprocessing arrangement and for generation of digital signals for tinnitus masking.

21. The system as claimed in claim 1, wherein the system is formed of an implantable part and an external unit, and wherein a PC-based, wireless telemetry means is provided for transmission of data between the implantable part of the system and the external unit.

22. The system as claimed in claim 21, wherein a re-writable implantable storage arrangement is associated with the signal processor for accommodating and reproducing an operating program, and wherein at least parts of the operating program are adapted to be replaced or changed by data transmitted from the external unit via the telemetry means.

23. The system as claimed in claim 21, wherein a buffer storage arrangement is provided for buffering data transmitted from the external unit via the telemetry means before relaying thereof to the signal processor.

24. The system as claimed in claim 23, wherein a checking logic is provided for checking data stored in the buffer storage arrangement before relaying thereof to the signal processor.

25. The system as claimed in claim 21, wherein there is a microprocessor module is provided for controlling at least one of A/D converters, D/A converters and the signal processor within the implantable part via a data bus.

26. The system as claimed in claims 24, wherein there is a microprocessor module is provided for controlling at least one of A/D converters, D/A converters and the signal processor within the implantable part via a data bus, and wherein the checking logic and the buffer storage arrangement are implemented in the microprocessor module.

27. The system as claimed in claim 25, wherein the system is adapted to transfer at least program parts between a source outside of the system, and the microprocessor module and the signal processor.

28. The system as claimed in claim 25, wherein an implantable storage arrangement for storing a working program for the microprocessor module is associated with the microprocessor module, and wherein at least parts of a working program for the microprocessor module are adapted to be changed or replaced by data transferred from the external unit via the telemetry means.

29. The system as claimed in claim 22, wherein there are at least two storage areas for holding and reproducing at least the operating program of the signal processor.

30. The system as claimed in claim 23, wherein the buffer storage arrangement has at least two storage areas for holding and reproducing data transferred from the external unit via the telemetry means.

31. The system as claimed in claim 19, wherein a preprogrammed read-only memory area which cannot be overwritten is associated with the signal processor.

32. The system as claimed in claim 20, wherein the telemetry means is adapted for

transmission of operating parameters between the implanted part of the system and the external unit.

33. The system as claimed in claim 1, wherein the system is completely implantable, except for a charging device and user controls, and is provided with at least one implantable acoustic sensor, and an electric power supply unit with a rechargeable electrical storage element, and wherein the charging device is a wireless, transcutaneous charging device for charging of the storage element.

34. The system as claimed in claim 33, wherein the user controls comprise a wireless remote control.

35. The system as claimed in claim 1, wherein the system is formed of an implantable part and an external module, wherein the at least one acoustic sensor, the electronic signal processing unit for audio signal processing and amplification, the power supply unit and a modulator/transmitter unit are contained in the external module which is adapted to be worn externally on a user's body, and wherein the implantable part is passive in terms of energy and is adapted to receive operating energy and converter control data via the modulator/transmitter unit in the external module.

36. The system as claimed in claim 1, wherein electromechanical converters are provided for excitation of fluid-filled inner-ear spaces of a damaged inner ear, and wherein the signal processing unit has driving signal processing electronics adapted to electrically trigger each of the electromechanical converters such that a traveling wave configuration is formed on the basilar membrane of the damaged inner ear which approximates the traveling wave formation of a healthy undamaged inner ear.

37. The system as claimed in claim 36, wherein the electromechanical converters are adapted for direct excitation of the fluid-filled inner-ear spaces of the damaged inner ear.

38. The system as claimed in claim 37, wherein the electromechanical converters comprise an intracochlear array.

39. System as claimed in claim 38, wherein the intracochlear converter array has a carrier of a biocompatible material which is biostable in the inner ear

40. The system as claimed in 39, wherein individual actuators of the intracochlear converter array are embedded in the carrier such that they are completely surrounded by a thin layer of carrier material.

41. The system as claimed in claim 39, wherein mechanical attenuation elements are embedded in the carrier between the individual actuators mechanical attenuation elements to minimize mechanical wave propagation within the carrier to adjacent converters.

42. The system as claimed in claim 41, wherein the material of the attenuation elements , for a cross sectional geometry similar to that of the carrier, has a high mechanical impedance as compared to the carrier material to achieve high attenuation values.

43. The system as claimed in claim 36, wherein the electromechanical converters comprise an extracochlear array of actuators in the form of electromechanical converters.

44. The system as claimed in claim 43, wherein the extracochlear converter array comprises a substrate which contains an electrical termination panel co-produced using microsystems engineering and which is adapted for connection of a multi-pin, biocompatible actuator feed line to the signal processing unit.

45. The system as claimed in claim 43, wherein a substrate is provided for the extracochlear converter array, the substrate being provided with an electronic module co-produced using microsystems engineering

46. The system as claimed in claim 44, wherein the electronic module includes at least one of driver stages for triggering the actuators, and decoding logic and converter modules for connection of a pin-reduced actuator feed line.

47. The system as claimed in claim 46, wherein the array is provided with a terminal for only three lines, a ground line, a data line and a clock signal line, and where the system is adapted to supply electrical operating energy by phantom feed on the clock signal line.

48. The system as claimed in claim 44, wherein the electronic module includes an interface module for digital data transmission via the actuator feed line.

49. The system as claimed in claim 44, wherein the electronic module includes D/A converters and driver modules associated with the actuators for serial data transmission on the actuator feed line.

50. The system as claimed in claim 44, wherein the actuators of the extracochlear converter array each have an output-side coupling element which is adapted to project through an opening of the cochlear wall into a fluid-filled inner ear space.

51. The system as claimed in claim 38, wherein the actuators in the converter array are distributed equidistantly along a basilar membrane of the inner ear.

52. The system as claimed in claim 38, wherein the actuators in the converter array are distributed along a basilar membrane of the inner ear at logarithmic distances according to tonotopic frequency-location assignment.

53. The system as claimed in claim 1, wherein the actuator arrangement has an electromechanical converter for mechanical stimulation of one of the middle ear or inner ear, and an intracochlear, electrically acting stimulation electrode array with at least one stimulation electrode for electrical stimulation of the inner ear.

54. The system as claimed in claim 1, wherein there is a dual intracochlear arrangement which has an actuator arrangement with at least one actuator element for at least indirect mechanical stimulation of the inner ear and an electrically acting stimulation electrode with at least one cochlear implant electrode for electrical stimulation of the inner ear.

55. The system as claimed in claim 54, wherein the actuator arrangement has at least one intracochlear electromechanical converter for direct mechanical stimulation of the inner ear.

56. The system as claimed in claim 54, wherein the actuator arrangement has at least one intracochlear hair cell stimulation electrode for indirect mechanical stimulation of the inner ear by electrical stimulation of external hair cells.

57. The system as claimed in claim 55, wherein the at least one electromechanical converter comprises a plurality of electromechanical converters and the at least one cochlear implant electrode comprises a plurality of cochlear implant electrodes, the electromechanical converters and cochlear implant electrodes being arranged alternating with one another along a common carrier.

58. The system as claimed in claim 36, wherein the electromechanical converter is one of an electromagnetic, electrodynamic, piezoelectric, magnetostrictive and dielectric converter.

59. The system as claimed in claim 36, wherein the electromechanical converter is a piezoelectric converter, and wherein the converter is made of one of PZT ceramic (lead zirconate titanate) or PVDF (polyvinylidene fluoride).

60. The system as claimed in claim 36, wherein the electromechanical converter is adapted to obtain a maximum deflection at a given converter voltage with minimum electric power consumption.

61. The system as claimed in claim 1, wherein, for rehabilitation of a hearing disorder of both ears, the system comprises a system unit for each of two ears of a user.

62. The system as claimed in claim 61, wherein the system units are essentially identical to one another.

63. The system as claimed in claim 61, wherein one system unit is a master unit and the other system unit is a slave unit which is adapted to be controlled by the master unit.

64. The system as claimed in claim 61, wherein a wired implantable line connection is provided; the signal processing modules being adapted to communicate with one another via the wired implantable line connection such that, in both system units, optimized binaural signal processing and converter array triggering are achieved.

65. The system as claimed in claim 61, wherein a wireless connection is provided, the signal processing modules being adpated to communicate with one another via the wireless connection such that, in both system units, optimized binaural signal processing and converter

array triggering are achieved.

66. The system as claimed in claim 61, wherein signal processing modules of the system units are adapted to communicate with one another using ultrasonic couplers via a solid borne sound-coupled ultrasonic section such that in both system units so that optimized binaural signal processing and converter array triggering are achieved.

67. The system as claimed in claim 61, wherein implantable electrodes are associated with the signal processing modules of the system units, and in an implanted state, are part of a data transmission section which leads through body tissue of the wearer for communication of the signal processing modules of the two system units.